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THE FUNCTION OF RESEARCH IN THE REGULATION OF NATURAL MONOPOLIES[1]

THE social and political unrest of the present day, which manifested itself strikingly in the recent presidential campaign, is of course due to more than one cause. Senator Root, in a notable speech recently delivered before the New York Chamber of Commerce, attributed this unrest in large measure to the mutual distrust and mutual misunderstanding existing between the leaders of the financial and industrial world, on the one hand, and the great body of the American people, on the other. To a large audience of bankers, merchants and captains of industry he said:

> There are hundreds of thousands of people outside our great industrial communities who think you are a den of thieves. There are hundreds of thousands of people who think the bankers and manufacturers are no better than a set of confidence men.
>
> We have before us now great and serious questions regarding the financial problems of the country, and this is what stands in the way of their solution: It is that the men who understand the finances of the country and the merchants engaged in great operations are under suspicion; great bodies of people will not accept what they say about finance. They will not accept what the experts say because they do not believe their motives are honest. . . . On the other hand, what is your attitude toward the people? There are many in this room to-night who down deep in their hearts believe that great bodies of the American people really want to destroy their business and confiscate their property. Now, neither of these things is true; but one misunderstanding leads to conduct which seems to justify another.

[1] Retiring presidential address before the Philosophical Society of Washington.

Senator Root then went on to say that there is nothing more important to-day than that by education and the spread of ideas such misunderstanding shall be done away with; that Americans shall interpret the spirit of popular government so that each shall be ready to do justice to the other, and every American shall desire the prosperity and happiness of every other American.

But while there is great force in what Senator Root says, it remains true that this social unrest springs in a measure from causes which the government can remedy.[2] The part which the government must play in our complex civilization is constantly increasing, and is immensely more important than in the simpler civilization of a century ago. In the early days the individual was much more independent, and each community was much less dependent on other communities than now. Society was simple, communication and commerce were limited, and relatively few laws sufficed. The twentieth century differs from the eighteenth in many respects, but in none more strikingly than with regard to the increasing complexity of business dealings.

The regulation and control of large corporations which have virtually secured the monopoly of particular industries is now receiving the attention of many of our leading scholars and statesmen, and the solution of the problem will be a triumph for popular government. The means that may be employed for this purpose are not so restricted as they formerly were. The public is becoming educated rapidly, and the constitution has greater capacities now than formerly.

STATE REGULATION OF NATURAL MONOPOLIES

While the federal government in the last few years has been striving to break up giant aggregations of corporations into their constituent parts, with the hope of getting these parts to compete with one another and so put an end to an undesirable monopoly, some of the states have been dealing in constructive fashion with another class of monopolies, and showing how they can be regulated and controlled to the end of conserving the best interests both of the public and of the stockholders. I refer to that very large and important class of corporations known as public-utility companies, chief among which are the steam railways of the country, city and interurban electric railways, gas and water companies, electric light and power companies and the telephone and telegraph companies. The federal government through the Interstate Commerce Commission has of course taken a leading part in this development, particularly with respect to the railways of the country, but the work done by some of the state public-service commissions, prominent among which are the commissions of Massachusetts, Wisconsin and New York, is of far-reaching influence and importance.

The attitude of the public regarding public utilities has been undergoing a profound change in recent years. Formerly a franchise for a street-railway or gas company, for example, was usually granted without compensation to the city, with few, if any, obligations on the company, with no control by the city over prices or service, and with extensions of the service into new territory optional with the company. Competition was sometimes sought by granting a franchise to more than one company, but generally such competition, if any, made the service poorer to the public as well as the profits less to the stockholders. If the business was profitable and the franchises valuable, city coun-

[2] In other words, the people acting cooperatively through their chosen representatives can remedy.

cils would be corrupted, if necessary, to get what was wanted. And, if the dividends were large, as they often were when no standards were set as to the quality of service and no limit set as to price, the capital would be sufficiently watered to keep down the dividends (capitalizing the value of the franchise, it was called). Occasionally a city became so dissatisfied with its gas or water or electric light company (either as to prices or service, or both) that in despair it built a new works, and two plants were operated where one, if rightly managed, would have served the public better.

ADVANTAGES OF A MONOPOLY

The change from this condition to the present (at least in certain states) is nothing short of revolutionary. It is now coming to be recognized that competition can not regulate rates in public utilities, and that one company can generally give better and cheaper service than two. It is a waste of capital and a disadvantage to a city to have two sets of gas or water pipes in the ground, or two sets of telephone or electric light wires and poles encumbering the streets. Having two telephone companies in a city forces a large proportion of their patrons to pay for both services; two street railway systems generally give less satisfactory service and fewer transfers than one would do. In short, these utilities are natural monopolies, and the highest efficiency and lowest rates are only possible when each one has the entire business of a given city or territory. So long as the right to regulate public service companies was denied, the idea of granting monopoly privileges was repugnant, and hence competition was encouraged with the hope of escaping the ill effects of unregulated monopoly. But now that the right and duty of regulating all public-service corporations is admitted by the companies themselves as well as by the courts, the ill effects of monopoly may be escaped and at the same time the beneficial results of economy and efficiency may be realized. To understand what effective regulation involves, we must consider the obligations imposed upon public utility companies, and the character of the service rendered by each.

When a community grants an exclusive franchise for a term of years or for an indefinite period to a corporation, with the right to regulate the quality of the service it shall render and the prices it may charge for such service, it undertakes a serious responsibility. The interests of the public must be safeguarded, but at the same time the interests of the company and its stockholders must be respected. A public-service commission, equipped with a full knowledge of the technical, commercial and legal aspects of the business, and endowed with a judicial spirit, will see that the following duties are fulfilled by each public-utility company in its jurisdiction:

1. To perform any duties especially prescribed by law.
2. To serve all who request service and make no discriminations.
3. To provide safe and adequate service.
4. To charge just and reasonable rates.
5. To fulfill its duties to its stockholders honestly and efficiently.[3]

REGULATION OF A GAS COMPANY

For example, a gas company receives a franchise to manufacture and sell gas for light, heat and power in a given city, for a

[3] This of course supposes that the commission has been given the necessary authority by the state legislature. Many of the public-service commissions were created as railroad commissions; and of these, some have had their functions extended to cover only a part of the duties mentioned above.

term of years, the city perhaps to have the right of purchasing the plant at the end of the franchise period. The quality of gas and the character of the service furnished, and the prices charged, are to be fixed by the public-service commission.

The commission must see that the company runs its mains into all the streets of the city, so as to give service to all; that uniform rates are charged and no rebates are allowed to favored customers; that service charges, if made, are reasonable; that the gas is of good quality, and as free from impurities as possible; that its heating value and candlepower are kept up to the standard specified; that the methods of testing and the instruments employed are up to date and satisfactory, and the persons doing the testing are competent; that the pressure of the gas is sufficient and not too great and does not vary enough to be dangerous; that gas appliances used are as safe as can be obtained, and connected in an approved manner; that the mains are properly located and properly protected from extremes of heat and cold; that the meters are kept in good order and tested from time to time as to their accuracy; that the prices charged are as low as possible, consistent with a reasonable dividend to the stockholders; that the books are kept in an approved form, so that the state of the business can readily be determined by the commission; that proper allowances are made for plant depreciation, or proper sums expended for upkeep; that no new stock is sold without approval by the commission, and that all dividends shall be from actual earnings, but that if actual net earnings are more than necessary to pay a reasonable dividend, the price of gas shall be reduced. This usually involves an appraisal of the company's property to determine whether the capitalization is fair. From time to time the specifications for the quality of the gas and the methods of testing must be revised; the question may arise as to what candlepower or heating value will give the best service under prevailing conditions; new methods of manufacture, new appliances and new uses for the gas will all bring up new questions; and the commission must be prepared to consider and decide upon all kinds of scientific, engineering and commercial problems as they arise in connection with the regulation of gas companies.

These duties are so many and so varied that one might suppose that it would be impossible for a commission to accomplish them all even for a single company, much less for all the gas companies in a state. If it had never been done, it would indeed appear doubtful. But these functions are being performed (at least in large part) so successfully in a few states that many of the other states are looking forward to doing it as soon as their commissions are prepared for the work. The gain from such regulation is not alone to the public, which pays for and uses the gas. The company is saved from unfair and hostile local legislation, which often forces resort to the courts, always an expensive and often unsatisfactory experience. The business is more stable, customers are better served and better satisfied, the credit of the company is often improved, new stock sells more readily and at higher prices, as the public knows the condition of the business and there is less risk to the investor. Stock manipulation is prevented, and those who profit by that process are the only ones to suffer.

REGULATION OF AN ELECTRIC LIGHT COMPANY

Similar duties devolve upon a public-service commission with regard to other utilities. Electric-light companies are

regulated with respect to their schedule of rates; discriminations which are so frequent under ordinary circumstances must be prevented; wires, whether overhead or underground, must be run in such manner as to reduce the danger to the public; high-potential wires must be especially guarded to keep them from telephone and other low-potential wires; alternating current transformers must be grounded on the secondary side, and the grounds must be made according to approved specifications; the steadiness of electric potential and uniformity throughout a given city must be satisfactory; proper precautions must be taken to safeguard the lives of the linemen and other employees of the company; the meters must be frequently tested and provision made for extra tests on complaint; portable and station instruments must be tested; lamp renewals must be regulated and prices approved for other than free renewals and rules and regulations made (in the absence of local rules) with respect to street lights.

REGULATION OF OTHER UTILITIES

Street railways and interurban electric railways must be regulated with respect to kind and quality of cars; the speed of cars and car schedules; kind of brakes, headlights, doors and other safety appliances; the method of car heating and amount of heating required; the method of car lighting and the quality and amount of light that must be supplied; how the current is distributed from the sub-stations to the cars, and the variations in voltage permitted between sub-station and cars; how the railway current is returned from the cars to the sub-stations, in order that the resulting electrolysis may do the minimum of injury to gas and water pipes, lead-sheathed cables and other underground structures; the repairs and upkeep of roadway and rolling stock; the fares to be charged and the conditions under which free transfers are issued; the wages paid employees and hours of labor; the conditions under which new stock may be issued; approval of plans for extensions or alterations of the system, etc.

Telephone companies must be regulated with respect to method of running their wires, so as to give the best and most reliable service possible under given circumstances; when and where wires must be put underground; the precautions to guard overhead wires against coming into contact with high-potential electric light or power wires; when and under what circumstances telephone and high-potential electric wires may be put on the same poles; the rates to be charged for different classes of service, both local and long distance; the service arrangements between different companies, the restrictions imposed by telephone companies respecting private exchanges and extensions; discriminations by a powerful company against smaller independent companies, etc.

Both the Interstate Commerce Commission and the state commissions deal with problems arising in connection with the regulation of the railroads, and these problems are numerous and of great importance. The first class of problems is connected with the fixing of freight and passenger tariffs, and discriminations in rates as between one locality and another or between one shipper and another. The second class of problems has to do with the operation of the road, with the safety and the adequacy of the service. This includes the question of the character of the roadbed and rails, the kind and quality of the engines and cars, the brakes and signaling apparatus, the kind of headlights and the candlepower and distribution of the light from the same; the heating, lighting and

ventilation of cars; the investigation of accidents; the weighing of freight and the testing of the scales, including the scales on which empty and loaded cars are weighed. These and many other questions may come before both state and federal commissions, but not all of them have been fully considered as yet by either. Similar duties pertain also to other utilities that are essentially monopolies, as telegraph companies, express companies, sleeping-car companies, water-supply companies, local express, transfer and cab companies. In so far as these utilities carry on an interstate business, they are also dealt with by the federal interstate commerce commission.

COOPERATION NECESSARY IN REGULATION

It appears from the above formidable, although incomplete, list of duties devolving upon a state public-utility commission that to fully measure up to its responsibilities would require a considerable staff of engineers, accountants and scientific assitants, besides its traveling inspectors and administrative officers. To decide many of the questions arising requires more technical knowledge than the experts either of the commission or the utility companies possess. Indeed, many of the questions can only be answered by extended researches carried out by scientists, engineers or statisticians working with the best of facilities. The interests at stake are in the aggregate so great that such researches ought to be made, and yet the cost would be too great for every state to do the work independently, or even for the richest of the states to undertake it alone.[4] The best way in which the work can be well done and kept up to date is for all the states to cooperate, and for the federal government to assist and coordinate the work. This is being done to some extent already, although comparatively few of the states as yet have commissions that are handling public utilities generally, and hence the work is only fairly begun. On the part of the federal government, the Interstate Commerce Commission and the Bureau of Standards are cooperating with the state commissions, the latter with regard to standards and engineering questions which fall within its province. Some of these questions may be mentioned briefly.

INSTRUMENTS AND STANDARDS

The instruments and standards employed in the measurement of heat, light and electrical power have been the subject of much study and investigation at the Bureau of Standards. The thermometers and pyrometers of various kinds employed in temperature measurements, and calorimeters of different types for use in measuring the heat of combustion of gases and solids, are calibrated and certified by the bureau, and standard samples of certified calorific value are furnished, so that the testing apparatus of public-service commissions, public-utility companies and consulting engineers will agree (or special tests be made if they disagree) and causes

[4] Extract from Professor R. T. Ely in his "Outlines of Economics," 1908:

"The tasks which confront such commissions are stupendous, and the expense of conducting their work, when it is properly conducted, is enormous. . . . On the whole, however, it is fortunate that the public have resolved to give this method of reform a thorough trial. It seems to be the next logical step in the evolution of natural monopoly, and does not appear to be attended with any grave danger. If it fails it will at least have trained up a corps of public servants thoroughly familiar with the operation of public-utility enterprises, and will at the same time have thoroughly convinced the people that there is no other alternative but public ownership and operation." This was written five years ago, and much progress has been made since then.

for dispute are thereby removed. The methods of testing with such apparatus have been studied by the bureau and sources of error in apparatus and methods determined. As manufacturing methods are developed and refinements in works control are introduced, greater accuracy in testing is required, and it is a great advantage to the industries to have uniform and reliable instruments, standards and methods.

The same may be said respecting the measurement of light and illumination. The candlepower of a gas flame depends upon the quality of the gas, the kind of burner used, the height of the barometer, the amount of moisture in the atmosphere and the degree of purity of the air in which it burns; hence, if the quality of the gas is to be determined (in part) by the candlepower given, it is necessary that the test be made under very definite conditions. The bureau has done considerable work on flame standards employed in gas testing, but much remains to be done in this respect. Photometric standards are supplied by the bureau for use in testing electric lamps of various kinds and colors, and gas standards are calibrated and certified. Thus, uniformity of value in light measurement is secured for the whole country, and indeed by means of international comparisons made by the bureau for the whole world, the international candle being the name of the unit of light universally employed in this country. Calibrations are also made of photometers and auxiliary apparatus. Similar uniformity, together with a much higher degree of precision, have been attained in electrical measurements. Electrical energy is sold by the kilowatt hour or the kilowatt year (or a combination of the two) and a large amount of testing is done by the companies and commissions to insure accurate measurement of the energy delivered. Here again uniformity and accuracy are promoted by having a national laboratory for calibrating and certifying standards and instruments, and settling such disputes as may arise from disagreeing measurements. A large amount of work has been done by the bureau to secure and maintain accurate standards and instruments, but much remains to be done, particularly with reference to the specifications of instruments and apparatus and the improvement of methods of measurement and testing.

In addition to its work on instruments and standards, the bureau has carried out other investigations which have a bearing on the work of the public-service commissions. One of these is concerned with the specifications of illuminating gas, and the methods of testing to be employed in controlling its quality.

REGULATION OF GAS COMPANIES

Among public-service utilities, none has been for so long a time and in so great detail subject to legal requirements and restrictions as the gas business. Such regulation is of course intended to insure good service. Many elements go to determine good or poor service, the principal of which (chemical purity, heating value, candlepower and condition as to pressure of the gas) are enumerated and defined more or less completely in many of the gas ordinances now in force, together with the tests that shall be made and the penalties for failure to meet the requirements. These ordinances are sometimes, therefore, very technical and contain detailed specifications. In other cases the specifications are very meager. In some cases old ordinances long since out of date, so far as their technical specifications are concerned, are still in use; in other cases, old ordinances have been extensively amended; in

still other cases entirely new ordinances have superseded old ones; in many cases no regulatory ordinances have ever been adopted. In some states possessing state commissions, the requirements have been fixed by the commissions. But in most states (and in all until recently) regulatory ordinances have been prepared and passed by state legislatures or city councils. The process of adopting such an ordinance is often long and painful. Suspicion, antagonism and often political considerations combine to make the negotiations difficult, and sometimes it amounts to a long-drawn battle. The representatives of the city endeavor to get all they can for the public, the company yields as little as possible. The result is generally unsatisfactory to both. Because the standard of performance demanded of gas companies in different cities and states was so different, and because so much difference of opinion existed among experts as to what could fairly be required of a gas company under given conditions, the Bureau of Standards took up about three years ago a careful study of the subject of state and municipal regulations of the quality, purity and pressure of illuminating gas supplied by gas companies.

INVESTIGATION CONCERNING REGULATION OF GAS COMPANIES

A compilation of all the state laws and city ordinances in force in the country was first made, and their technical requirements tabulated. A detailed study was then undertaken of the various features of such laws, and an attempt made to formulate a model law that should contain reasonable standards of quality, purity and pressure, and a reasonable set of operating requirements. In this study, a large number of the best informed gas experts in the country were consulted, and many gas plants visited. In this work the bureau has been assisted by the responsible officers and members of the technical staffs of gas companies and by members of public-service commissions, gas inspectors and consulting engineers. The bureau has endeavored to consider all sides of the various questions involved, and has of course received very conflicting opinions on some questions. It has been a source of great gratification to those conducting this investigation to see the fairness and broad-minded spirit shown generally by representatives of the gas companies in discussing questions that affected them so vitally. They have met a spirit of fair play by a corresponding willingness to reach just conclusions.

The results of this investigation were published by the Bureau of Standards, and the paper has had a wide circulation and careful study by those most interested in the subjects treated. Since its publication, the bureau has continued to study the subject, and is now preparing a revision of the first edition. The compilation of laws and ordinances will be revised and some important changes will be made in the model ordinance proposed. These changes are, however, being discussed very fully before publication, both with representatives of the public-service commissions and of the gas companies, the latter including a special committee of the American Gas Institute.

The position of the bureau in this matter, as in so many others, is advisory. It has no authority to enforce its conclusions and no disposition to suggest federal legislation or regulation. It acts as an unbiased coordinating agency, to formulate the results of its own and others' investigations and to give expression to the consensus of opinion of those best qualified to

express opinions on technical questions of great practical importance.

A second investigation (already alluded to) is in progress on the methods and instruments employed in testing gas for its heating value, its candlepower and its chemical purity, as well as in testing meters and measuring gas pressures. This will be embodied in a separate publication which will be frequently revised and kept up to date, in order to be as useful as possible to gas inspectors and engineers in determining whether gas meets the specifications under which it is sold.

A third investigation scarcely begun, but which is much needed and deserves extensive study, is on the safety and efficiency of gas appliances. Too many fatal accidents result from defective gas appliances, and the contamination of the atmosphere through imperfect combustion due to defective appliances is a serious matter, even when no fatalities result. This is a question in which cooperation of all the interests concerned can not fail to yield important results.

INVESTIGATIONS OF ELECTROLYSIS

Another important investigation carried out by the Bureau of Standards, which also concerns public-utility companies, is the damage by electrolysis produced by street railway currents flowing through the earth, upon gas and water pipes, lead-covered cables belonging to telephone, telegraph and electric-light companies, and the reinforced concrete foundations of buildings and bridges. Such insulated double conductor systems as those of New York, Washington and Cincinnati provide for the return of the current to the power houses without flowing through the earth, but most cities use the single overhead trolley, and permit the current to return in part through gas and water pipes and other underground conductors. Where the current leaves such metal conductors, the latter are corroded electrolytically, and in some cases holes eaten through, thereby interfering with the service and involving expensive repairs. Many remedies have been proposed, but as yet comparatively little has been done to cure the evil. The bureau undertook a thorough study of the question for the purpose of testing some of the proposed remedies and arriving at a solution of the difficulty, if possible, that could be applied generally. This investigation is not yet completed, but already valuable results have been reached and it is hoped that shortly information will be made available for the use of the street railways that will permit them greatly to reduce the volume of the currents flowing through the earth without unreasonable expense, and that will enable the public-service commissions to deal more intelligently with the question. The problem is becoming each year more acute, since the volume of electric current used is each year increasing as the traffic increases, and the damage produced is therefore increasing at an increasing rate. Many lawsuits have arisen because of this damage, and such litigation is expensive because of the large amount of conflicting expert testimony adduced and the long time consumed in the trials. Money expended intelligently in solving the problem generally yields better returns than money spent in litigation.

In England and some continental countries there have been rules on this subject which have served as a guide to the electric railways in building their roadways, and hence they have been saved very largely from the evil effects of electrolysis, although at a somewhat increased first cost. In this country the subject was neglected for years. In the absence of public-service

commissions or similar bodies to establish regulations, and no government agency to take the lead in the investigation, the matter has been entirely neglected in many cases until the serious damage resulting has made the question a very acute one.

LIFE HAZARD IN ELECTRICAL WORK

Another question affecting public-utility companies is the life hazard in electrical work. There are altogether too many preventable fatalities due to high-potential electrical circuits, not only to employees of the electrical companies, but also to the public. In many cases such accidents could have been avoided if the companies had taken greater precautions, either by instructing their employees more carefully, or providing them with rubber gloves and other protective devices, or having repairs made only on dead lines, or using more substantial and more expensive construction, or running the high-potential transmission lines on private rights of way instead of on the highway, or keeping the dangerous wires away from telephone wires and on separate pole lines, or taking still other precautions which experience shows are necessary. The long-distance transmission of power is being resorted to more and more, and higher voltages are being used than a few years ago would have been thought possible. One thousand volts is a dangerous voltage, but transmission at fifty to a hundred thousand volts is becoming common. As water power is utilized more and more, the country will finally be covered with a network of high-potential transmission and distribution lines, and it is a matter of vital concern that all reasonable precautions be taken in the construction and operation of such lines. So long as public utilities were regarded as private business and a company was free to make as much money as possible and invest as little as possible in its plant, the tendency was to economize unduly with respect to protective devices, and any construction that was more expensive than the mechanical or electrical requirements demanded was avoided. But when we regard railroads, electric light and power companies and telephone and telegraph companies not only as public utilities, but as quasi-public institutions, and permit them to charge enough to make a good profit, but to make the rates as low as good service permits, then it is seen that the public pays for the cost of protection, and it is entitled to require that every reasonable precaution be taken to safeguard human life. This latter is the view which is now becoming general, and the public-service commissions are therefore greatly interested in having rules and regulations worked out in such a way as to be capable of enforcement upon the electrical companies. On the other hand, the electrical companies themselves are anxious for such information. It is not necessary to make original investigations in every case; it is often a question of collecting and digesting the information already in existence, and with the cooperation of numerous agencies which stand ready to assist, work out a body of rules and regulations that will be as useful as possible. Congress has recently made a special appropriation to permit the bureau to undertake such a study of the life hazard in electrical work, and it is hoped that valuable results may be accomplished.

RAILROAD SCALES

Another investigation of great practical importance, in which the Interstate Commerce Commission and the Bureau of Standards are cooperating, is the investigation of the accuracy of railroad scales, especially car scales, for weighing freight.

Freights to the amount of two thousand millions of dollars are annually collected by the railroads on weighings made with scales, most of which are seldom tested and, except in three western states, never officially inspected. Numerous disputes and complaints could be avoided if the scales were officially tested and certified, and if provision were made for retesting on complaint. Certainly, it is as important to test large scales as small ones, and the cost of doing so is trifling in comparison with the enormous interests at stake.

LOCOMOTIVE HEADLIGHTS

Another subject with which some of the state commissions have dealt is the kind of headlights used on locomotives, their candlepower and reliability. In some states legislation has been enacted requiring a particular kind of headlight. It has been charged that such legislation in some cases has been inspired by commercial interests. In one state the commission issued a rule requiring a certain candlepower, but not specifying how it was to be measured or exactly what was meant. The railroads, contending that the order was ambiguous, impossible to comply with by one interpretation and undesirable by another interpretation, appealed to the courts. After a lengthy and expensive litigation the order of the commission was set aside. This case is cited to illustrate the need of technical information by state commissions before issuing mandatory orders, and also the hardship to railroads or other public-utility companies to be obliged to contest in the courts orders that work a hardship and which would not have been issued if full information had been at hand. There is great need of further investigation of the subject of headlights for use on steam and electric railways, to determine the best service that different types are capable of giving, and to formulate rules that could be enforced by the commissions. Some railroads economize unduly on the maintenance of headlights; in the interest of safety to the public, wise regulations should be in effect.

CAR LIGHTING

The lighting of cars (both steam and electric) is another practical matter that has not received the attention that it deserves. Most people read more or less on trains and street cars, and with many who ride a long distance to and from business this is their best time for reading. As a rule, however, the lighting of cars is insufficient and the arrangement of lights is often atrocious from the point of view both of the passengers who are not reading and those who are. Eyesight is too precious a possession and too easily injured to justify the continuance of poor lighting of cars. Better light is required than would be necessary if the cars were not moving. The problem is different on electric cars from what it is on steam cars, because in the former the current for lights comes from the same circuit that supplies the motors, and hence great variations occur due to the fluctuating voltage on the trolley wire. To secure better lighting, (1) a steadier voltage should be available, (2) better lamps should be used than are generally seen in electric cars, (3) a greater quantity of light should be available and (4) the lamps should be so shaded and so located as to keep the glare out of the eyes of the passenger, and yet give good illumination for reading. The immense importance of this subject can only be realized when one considers the millions of people who daily spend considerable time in steam or electric cars, and how much better the service would be if the cars were pleasantly and sufficiently lighted. The

public-service commissions have it in their power to effect an immense improvement in this respect, but first a thorough investigation should be made, with the cooperation of the railroads, to show what are the best methods to follow, and what it is practicable to accomplish with present resources.

HEATING AND VENTILATION OF CARS

Another question of great practical importance is the heating and ventilation of cars, including Pullman sleeping-cars. Any person who has sweltered in an overheated, unventilated lower berth of a sleeping-car (and who has not), will allow that there is great room for improvement. Surely the resources of American invention have not been exhausted in this direction, nor, indeed, with respect to heating and ventilation of day coaches. It is one of the functions of public-service commissions to see that the health and comfort of the public are kept in view by the utility companies, and if it can be made clear what should be done in this respect, the way to reform is open.

RAILWAY ACCIDENTS

Another line of work which deserves an immense amount of investigation and study, and cooperation between the states and the federal government, is the prevention of railway accidents. Much has been done and is now being done, both by federal and state agencies, and by the railway companies; but far greater sums of money might well be expended by the states and the federal government in a systematic investigation of all phases of this question. It is nothing short of a national disgrace that American railways should kill and injure so many more people than do the railways of European countries, even where the speeds are as high and the passenger traffic as heavy. Life is too cheap with us, and the penalty for disasters too slight. The causes of these accidents are partly physical and partly psychological; no doubt greater attention given to the subject of how to prevent both kinds of accidents would be abundantly rewarded.[5]

Other subjects deserving research could be named that fall within the province of the public-service commission, but enough has been said to show how important are their functions apart from the duty of fixing rates and preventing discrimination. These illustrations show how much better it is for the public as well as the companies that the commissions regulate by cooperating with and assisting the companies instead merely of dictating to them what they shall do or shall not do; that the scientist, the engineer and the statistician are more useful to them in their work than the lawyer; that the bar of public opinion is more effective than the courts in enforcing their decrees. Many of these utilities are operated by big corporations, owning scores of plants in many states; in the case of the telephone and telegraph, they are gigantic systems operating over the whole country. It is therefore important that the rules and regulations in the different states shall be as nearly uniform as possible. Hence, in order to reach wise and just conclusions, and to secure uniformity,

[5] A recent writer states that 19,377 more persons were injured on railroads in the United States in 1912 than in 1911, and commenting on the slight amount of scientific information that has been collected regarding the causes of accidents, he adds:

"The railroads of this country carry so many passengers and so much freight that in one year they are able to charge three billion dollars for the service. And yet it is admitted that no accurate engineering data showing the actual stresses which are set up in railway structures by locomotives and cars of different weights and moving at different speeds has ever been gathered."

it is important that the states cooperate with one another, and the federal government can serve as a valuable aid and coordinating force in this cooperation.

The results that are being attained in this way are only beginning to be realized. They will be of invaluable benefit, not only to the public served, but to the companies themselves, and to the cause of good government. With the utility companies under the control of business-like state commissions, the business is better managed,[6] discriminations in rates are eliminated,[7] the utilities are taken out of local politics and the possibility of pure municipal government in America is enormously enhanced.[8]

One of the best results of the method of regulation by public-service commissions is the publicity it secures of the affairs of the company and the confidence it establishes in the public mind in the various utility companies. The suspicion and distrust which Senator Root emphasized so strongly in his New York address is everywhere felt toward these companies when their affairs are kept secret, and especially when the service is poor and the dividends good. Controversies arise which sometimes degenerate into bitter and partisan feuds. Who can feel kindly toward the management of a street railway company if he is usually compelled to ride as a strap-hanger, or toward a gas company if the rates are excessive or he believes that his meter races, or toward any company that appears to regard its franchise as the deed to a private monopoly. If the service is improved or the rates reduced as the business grows more prosperous, the people as well as the stockholders derive benefits from success. The public soon realizes that utilities so conducted are in effect partnerships between the public and the stockholders, and are willing that the latter receive increased dividends with increased prosperity if the public is permitted to share the fruits of success. The sliding scale of prices for gas is a successful example of this system, but it is also realized in many cases where a sliding scale of prices has not been fixed in advance. The regulation of prices by a commission gives

[6] B. H. Meyer, speaking on the Wisconsin Public Utilities Commission at the Pittsburgh meeting (1908) of the National Municipal League, said:

"The utility law is working a revolution in business management. . . . Many of the utility companies have not been operated on a business basis; in fact, it is probable that a good many of the managements did not have the remotest idea as to the exact standing, from a business point of view, of the plant they were operating. Uniform accounting and rules governing the service and the regulation of rates, compel the adoption of business and scientific methods. This is resulting in nothing short of a revolution in management."

[7] The whole state of Wisconsin was literally streaked and plastered with discrimination in the rates of utilities, and in all the rest of the country, where the extent of the discriminations have not yet been determined, as they have been in Wisconsin, it is quite probable that discriminations similar in character and extent likewise exist.

[8] Governor McGovern has this to say regarding the utilities and politics in Wisconsin:

"Times were in Wisconsin when the railroads ran or tried to run the government of the state, and the minor utilities sought to boss the cities, towns and even villages. They contributed liberally to campaign funds, urged their supporters and lobbyists to become candidates for public office, and in close election districts colonized voters in the old conventional way. Now, one and all, they are in this sense absolutely out of politics. There is, indeed, no reason now why public-service corporations in Wisconsin should wish to dabble in public affairs. Their relations to the people of the state have been definitely and finally determined. They no longer have anything to gain or lose by intermeddling in politics, and apparently they have decided to retire for good. What the elimination of public-service corporations from participation in political campaigns signifies in the purification of public life, no one here needs to be reminded."

in effect a sliding scale, by which either the price goes down or the quality of the service goes up, as the success of the business justifies it. For want of a public-service commission in the District of Columbia, the Interstate Commerce Commission has recently been exercising the functions of such a commission with respect to the street railways, and with good effect. There is great need of a full-fledged public-service commission in the district, and it is hoped that Congress in its wisdom will respond to public sentiment and establish such a commission.[9]

How infinitely better is this method of regulation than the building of publicly-owned utilities to compete with private plants already in existence. For a state or city to say that it is impotent to regulate a public utility is a confession of weakness; but there is far greater difficulty in city control than in regulation by state commissions. Except, perhaps, in the largest cities, it seems much better to have strong state commissions, well equipped with technical assistants, than to have separate commissions for each city. And with the cooperation of other states and the federal government, any state commission can establish its work with only a fraction of the effort and expense required by those states that have pioneered the movement.[10]

Turning now to the great industrial and financial corporations popularly called trusts, the question suggests itself whether it is possible for the government to regulate them in a manner similar to the regulation of the natural monopolies we have been discussing, so that full publicity may be secured, the rights of the public may be conserved, and at the same time the rank and file of the stockholders will be protected from the vultures that often hover over the executive offices of such concerns. One can not say that it will be done as easily, but it is coming to be believed that the general method adopted in the regulation of public utilities is the right one, namely, less dependence on law and the courts, and more dependence on engineers, statisticians and business experts; that the government should prescribe affirmative duties for the giant corporations, and not merely negative ones; that a constructive policy that would benefit both the business concerns and the public they serve should be sought, rather than a retrograde policy that is no benefit to the business and does no good to the public. If such regulation could be realized, and consolidations and promotions in business could be limited to such as would benefit both the public and the stockholders, and not merely big financiers and promoters, it would be a notable achievement in our political as well as economic history. It would assist mightily in the peaceful settlement of industrial disputes and in the bringing about of a better understanding between capital and labor.

It is just as reasonable to expect the government to perform this function of regulation of monopolies as to expect it to adjust international disputes by arbitration rather than by war. It is not socialistic, but rather the reverse, for it is the alternative of state ownership. In Germany the cities are great business concerns operated by business men for the benefit of the people, and as such they are models for the whole world. They own and operate most of the public utilities themselves, and do it well, and hence the necessity of public regulation is there less

[9] A public-utility commission for the District of Columbia has been established by Congress since this address was delivered.

[10] Writing in 1908, Professor Ely said: "States having commissions empowered to enforce uniform accounting will constitute great economic laboratories in this connection during the next quarter of a century."

felt, although it has been practised for many years. But in this country, municipal ownership has been less successful, except in the case of municipal water supplies.

There have been three stages in the modern history of natural monopolies. In the first they went unregulated, being operated for the profit of the owners and exploited for the benefit of financiers. In the second stage, regulation was by legislation and lawsuit. In the third, regulation is by commission; the regulation is more complete, as well as more intelligent, and cooperation and publicity are keynotes of the method.

The large industrial corporations which have virtual monopolies, are mainly in the first stage, although some are in the second. Whether they will finally come to the third stage, and be regulated by the methods now applied so successfully to natural monopolies, remains for the future to determine.

If state regulation of natural monopolies becomes as general within a few years as it promises to be, and if it is as successful generally as it has been in the few states which took it up first, it will solve the problem of public utilities and largely solve the problem also of good municipal government.

The signal success of the Wisconsin Commission was largely due to the influence of the University of Wisconsin. In its personnel and methods it was a scientific commission, and entered into its work with the spirit of investigators. Its spirit and its methods have been adopted by some of the other state commissions, of which a large number have been created recently and are now taking up their work.

If the administrative officers of the commissions are assisted by scientists, engineers and economists, and the work is done in a judicial spirit, as new problems being taken up as a scientific research would be, the states and federal government acting in full cooperation, with the experience of each available to all—if the work is done in that way we may be certain that success will be sure and permanent.

EDWARD B. ROSA
BUREAU OF STANDARDS

THE NINTH INTERNATIONAL CONGRESS OF ZOOLOGY AT MONACO

UNDER the presidency of Prince Albert I. of Monaco, the congress was formally opened in the beautiful Museum of Oceanography on March 25. In his opening address the prince, after referring to the basic importance of the study of marine life and the conditions under which it exists, for one who desires a reasonable conception of the problems of biology, spoke of the prime value of the study of zoology as an aid in the solution of many of the problems confronting human social groups. He very cleverly pointed to the Principality of Monaco as a community where the life of the people is illumined by the light of science, and where the climax of all the activities of the state is a noble scientific institution devoted, not only to the investigation of the deep sea and its life, but to the application of the facts thus discovered to the daily life of the people.

For the reading of papers the congress was organized into eight sections, which, with the number of titles on the program of each, were as follows:

I. Comparative Anatomy and Physiology. 32 titles.
II. Cytology. General Embryology. Protistology. 25 titles.
III. Systematic Zoology. Behavior. 26 titles.
IV. General Zoology. Paleozoology. Zoogeography. 13 titles.
V. Oceanic Biology. Plankton. 8 titles.
VI. Applied Zoology. Parasitology. Museums. 15 titles.
VII. Nomenclature. 9 titles.
Sub-Section VIII. Entomology. 10 titles.

Three general sessions were held, upon the

programs of which there were thirteen additional titles.

An American zoologist could not fail to be struck with the relatively small number of titles lying in the experimental phases of zoology, and so complete has become the divorce between continental zoology and genetics that the program of the congress contained but two titles within the latter field.

The topic subtending the widest angle, both in informal discussion and in the business of the congress, was that of nomenclature, more specifically, the advisability of continuing the application of the rule of priority adopted by the International Commission on Nomenclature. This question was discussed first in the section on nomenclature, where the opinions of American zoologists were presented chiefly by Dr. Stiles, Professor Williston and Dr. Field. The section first resolved to recommend to the congress the proposal of Dr. Field, that an author might, in special instances, present to the commission a request that a name be established although not in accordance with the strict priority rule. Such cases were to be transmitted to a sub-committee of specialists and to be published before their adoption. If the commission were unable to accept the decision of the sub-committee, an appeal might then be had to the congress at its next meeting.

Later, however, the section on nomenclature reversed this action and made a recommendation which was finally presented to the congress and adopted by a large majority. A precise statement of this action will doubtless be published later, but in substance it is as follows. The International Commission on Nomenclature is given full power to suspend the rules of nomenclature, including that of priority, in special cases presented to it by authors, with the understanding that the commission will confer with specialists in the groups concerned before coming to a decision. If then, the vote of the commission should be unanimous, the suspension of the rule in that case becomes effective immediately; if two thirds of the commission favor the suspension, the question is to be laid before a special committee of three, to be appointed by the president of the section on nomenclature, at the subsequent meeting of the congress, this committee to consist of one member favoring the suspension, one opposed to it, and a third, whose opinion has not been formed.

The result of this action is primarily to free the commission from the obligation of a strict adherence to the application of the priority rule. Whether this action will permit a reasonable flexibility in the interpretation of the rules of nomenclature, of course remains to be seen. To many it seems regrettable that so much of the time and work of these congresses must be devoted to the discussion of so special a topic, and one so indirectly related to the advancement of zoological knowledge.

At the last general session on March 29, the award of the Emperor Nicolas II. prize was made to Professor Ernst Bresslau, Strassburg, for his work on the mammary organs of the lower mammals, and to Professor Th. Mortensen, Copenhagen, for his investigations of the invertebrates of the Arctic oceans. The O. Kowalewsky prize was awarded to Professor Paul Pelseneer, Gand, for his well-known work on the phylogeny of the Mollusca. At this meeting Budapest was selected as the place of the tenth congress, in 1916, and Professor G. Horvath, of the Hungarian National Museum was elected president of that congress.

The social events of the congress were especially brilliant, thanks to the hospitality of Prince Albert I., and these added to the wonderful natural beauties and charms of Monaco, combined to render the congress a memorable occasion.

The congress was very largely attended, the enrollment of members reaching approximately seven hundred, a considerable number of whom were, however, not able actually to be in attendance. While the date of the ses-

sion was particularly favorable for European members, a general attendance of American zoologists was practically impossible.

Following is a list of the members present from North America:

Dr. J. A. Allen, American Museum of Natural History. "Individual variation in musk oxen."

Mr. E. Phelps Allis, Menton.

Professor and Mrs. Ulric Dahlgren, Princeton University. (*a*) "A remarkable polarity in the motor nerve cells of the electric apparatus of *Tetronarce occidentalis.*" (*b*) "Embryonic history of the electric apparatus in *Gymnarchus niloticus.*"

Dr. and Mrs. H. H. Field, Concilium Bibliographicum, Zurich.

Miss Katherine Foot, New York City. "Results of crossing three Hemiptera species with reference to the inheritance of an exclusively male character" (with Miss Strobell).

Professor F. H. Herrick, Western Reserve University.

Professor and Mrs. W. E. Kellicott, Goucher College.

Dr. and Mrs. Leonard Stejneger, Smithsonian Institution.

Dr. and Mrs. C. W. Stiles, U. S. Bureau of Public Health. "The distribution of *Necator americanus* in the United States, its medical and economic importance and the campaign for its eradication."

Miss E. C. Strobell, New York City.

Professor S. W. Williston, Chicago University. (*a*) "The Amphibia and Reptilia of the American Permo-Carboniferous." (*b*) Communication on "Nomenclature."

Professor and Mrs. R. Ramsey Wright, University of Toronto.

WM. E. KELLICOTT

THE TARR MEMORIAL WINDOW

ON March 23, 1913, a memorial window, by Tiffany, was unveiled in Sage Chapel of Cornell University. It was given by Mrs. Tarr and accepted, for the university, by acting president T. F. Crane. The presentation and description of the window, by Lawrence Martin, follows.

This memorial window, dedicated to the late Ralph Stockman Tarr, is given by Mrs. Tarr to Cornell University. Thus the present and future generations of Cornell students and of worshipers in this chapel will be reminded of one who was a faithful and inspiring teacher and a great scientist. During the score of years through which he was professor of dynamic geology and physical geography at Cornell University he made a deep impression upon the minds and in the hearts of those of us who were so fortunate as to come in contact with him in the home, in the lecture room or laboratory, or in God's great outdoors.

The memory of Professor Tarr is fresh with all of those present. It is just a year since we were gathered here to pay our last respects at his funeral. Upon this Easter afternoon and in presenting this memorial window I may perhaps be permitted to say briefly some of the things with which all our hearts are filled.

Professor Tarr's life was a wonderful example to young men. I may speak of his determination to get an education, a determination which led him to enter Harvard University and to work his way through college, and, in the early years, even to travel sixty miles each day to and from his recitations while he lived at his parents' home.

I may speak of his hard work while he was a professor at Cornell, sparing no pains to make his lectures and his laboratory and field work clear, interesting, disciplinary and scientifically sound. The hundreds of students who have taken Professor Tarr's courses are the best fruits of this work, for none of them but gained with their knowledge of geology and physical geography a sense of admiration and affection for the teacher.

I may speak of the imparting of his knowledge of the facts of geography to the hundreds of thousands of readers of his books—books which were written with the utmost regard for truth and for the upbuilding of character by the example gained in learning how one's fellow men are utilizing the great resources of the earth and adapting themselves to the diverse environments in which the Almighty has placed them.

I may speak of his years of investigation. Professor Tarr was always a student. The success of his teaching and of his writing of

books depended largely upon the almost incessant travel in which his summer vacations and sabbatical years were spent. In every state in the union, in most of the countries of Europe, in the West Indies and Central America, in Greenland, in Spitzenbergen, in Alaska, Professor Tarr studied. For he traveled not as a sightseer but as a student, as one who would learn the secrets of nature that he might impart them to others. Work and service. These were the keynotes of his life.

The window which has just been unveiled on the south side of Sage Chapel is typical of Professor Tarr's life of work and service. It represents the valley of a river. In the background rise the mountains, capped by the eternal snows, perhaps containing, in their valleys, glaciers such as Professor Tarr made his especial study. Here is the source of the river, which flows steadily because it is fed by the rain and by the melting snow of the mountains, the pure snow which typifies the innocence of youth.

In the middle distance the river is flowing through a broad, open valley, a valley which has been made by the river itself, a valley which, by the erosive action of the stream, is being made broader and therefore more suitable for habitation by man. The river must widen and deepen its valley, it must carry away the material which is here an encumbrance, but which the river will later deposit on the lower land where it will be of most use to man.

In the foreground the river is in a narrow gorge. This stream has encountered a temporary obstacle in its course. To remove this it uses the very material which it is carrying forward to the sea. Soon it will widen the gorge into an open valley like that of the middle distance. Work is necessary in accomplishing this, hard work in order that the valley may have gently-sloping walls upon which man may plant his fields and in order that the stream bed may slope gently so that the river may do its service in carrying the products of the fields to the markets and towns.

Now most rivers also have lower courses, places where there are broad floodplains and deltas, where the river has deposited rich soil, carried down from the mountains, where the river flows slowly, its hard work nearly done. As in the life of rivers with hurried course and hardest tasks in the youthful section near the mountains, and leisurely current and little work near the mouth, where the river terminates in the all-embracing ocean, so with man. Only in the case of Professor Tarr the river which typifies his life shows no leisurely old age. You will recall that he died on March 21, 1912, at the age of forty-eight. His was a life of hard work, of toil and service. But although he was not permitted to enjoy the years of less strenuous labor, the effort was not in vain. We, his relatives and friends and students, will profit largely, throughout the years to come, by the work which he has placed at our service.

May this memorial window which I now, on behalf of Mrs. Tarr, present to Cornell University ever recall the memory of the work and service to others that was performed here by Ralph Stockman Tarr.

SCIENTIFIC NOTES AND NEWS

At the semi-centennial celebration of the National Academy of Sciences to be held next week, the medals and prizes of the academy will be presented by the president of the United States. The first award of the Comstock prize, of the value of $1,500, will be to Professor R. A. Millikan, of the University of Chicago, for his researches on the charge of the electron, the ratio of electric charge to mass and gaseous ionization. The Henry Draper medal has been awarded to M. Henri Deslandres, director of the Astrophysical Observatory at Meudon, for his researches in solar and stellar physics.

The Henry Phipps Psychiatric Clinic, of the Johns Hopkins Hospital, established and erected by Mr. Henry Phipps, of New York, to promote the study of mental disease and its early treatment, was dedicated on April 16, and the exercises will continue during the two following days. Addresses were announced

by Sir William Osler, Professor W. MacDougall, Professor E. Bleuler, Dr. F. W. Mott, Professor O. Rossi, Professor Heilbronner, Dr. Achucarro and a number of leading American psychiatrists, including Professor A. Meyer, the director of the clinic.

THE first lecture on the Joseph Leidy Memorial Foundation was delivered at the University of Pennsylvania on April 17 by Professor Edmund Beecher Wilson, Columbia University. A tribute was paid, on this occasion, to the life and services of Joseph Leidy, the student, teacher and investigator, by Professor Charles Sedgwick Minot, Harvard University.

A MEETING in commemoration of the life and work of the late Dr. John Shaw Billings, late director of the New York Public Library, will be held in the library building on April 25.

KING VICTOR EMMANUEL presided on March 27 at the inauguration of the International Geographical Congress, Rome.

THE National Geographic Society has voted $20,000 to the Norwegian Polar Expedition, which will leave the Pacific coast under command of Captain Roald Amundsen in June, 1914, to explore the polar basin. The voyage, it is expected, will require four years' drifting in the polar ice.

DR. DAVID SHARP, Lawnside, Brockenhurst, Hants, England, and Dr. J. H. Fabre, Serignan, Vancluse, France, were chosen on April 3 as the first two honorary members of the Entomological Society of Washington. The Entomological Society of Washington may elect ten honorary members from among foreign entomologists.

WE regret to learn that Professor Willet M. Hays, assistant secretary of agriculture, under the Roosevelt and Taft administrations and formerly professor of agriculture in the University of Minnesota, is suffering a serious nervous breakdown and is taking treatment at a sanitarium near Washington. Professor Hays had recently accepted a commission from the government of Argentina to reorganize the rural educational system of that republic, but his illness will make it impossible to assume the duties.

DR. L. A. BAUER sails from New York on April 22, to be gone for about two months, in order to arrange for cooperative magnetic work between the Department of Terrestrial Magnetism and various foreign institutions. On May 22 he will deliver the Halley lecture on "Terrestrial Magnetism" at the University of Oxford.

PROFESSOR H. T. BARNES, of McGill University, will accompany the government steamer *Montcalme* to patrol the entrance of the Gulf of St. Lawrence, to report the presence of icebergs. Professor Barnes will use his microthermometer to detect the presence of ice.

PROFESSOR H. T. FERNALD, of the Massachusetts Agricultural College, sails for Europe the last of April, for study in various European museums. He will return about the middle of September.

A JAPANESE translation of "The Elements of Statistics," by Wilford I. King, of the economics department of the University of Wisconsin, has been made. The book has just passed through its second English edition.

DR. LAFAYETTE B. MENDEL, professor of physiological chemistry in the Sheffield Scientific School of Yale University, addressed the students of the Pratt Institute in Brooklyn, on April 11 on "Nutrition and Growth."

ON April 7, before the Southern California Academy of Sciences, Los Angeles, Dr. D. T. MacDougall, director of the department of botanical research of the Carnegie Institution, delivered an address on "Some Physical and Biological Features of American Deserts."

DR. H. L. FAIRCHILD, professor of geology in the University of Rochester, delivered a lecture at Syracuse University under the auspices of the Syracuse Chapter of Sigma Xi, on the evening of April 11. He took for his subject "Remarkable Glacial Drainage Features about Syracuse."

PRESIDENT CHARLES R. VAN HISE, of the University of Wisconsin, delivered an address on "Waste in Distribution" before the first

National Conference on Marketing and Farm Credits, held in Chicago on April 8.

The New York Academy of Sciences will hold a reception on April 21, when an illustrated lecture will be given by Professor Bergen Davis, of Columbia University, on "Electricity as Revealed by its Passage through Gases." The lecture will be followed by a reception.

Oscar Dana Allen, whose death has been noted in Science, was born in Maine in 1836. In 1871 he was elected professor of metallurgy in the Sheffield Scientific School of Yale University. In 1874 he was also made professor of analytical chemistry. Prolonged ill health obliged him to resign these two positions in 1887, when he moved to California for four years. After that he lived at what is now called Ashford, a remote place situated at the base of Mount Ranier in Washington. There he devoted himself to horticulture, botany and biology, making the flora of the mountain near which he lived his special study.

Dr. Bela Lengyel, professor of chemistry at Budapesth, has died at the age of fifty-nine years.

Dr. Eduard Schmitt, formerly professor of engineering in the Darmstadt Technical School, has died at the age of seventy-one years.

A site of about seven acres, in the District of Columbia and near Rock Creek Park, has been purchased by the Carnegie Institution of Washington to provide the necessary facilities for the office and experimental work of the Department of Terestrial Magnetism. The building to be erected is to embrace the office, laboratory and instrument shop; according to present expectations, it will be ready for occupancy early in 1914.

The magnetic survey yacht *Carnegie* left St. Helena on April 9, bound for Bahia, and is expected to return to her home port at the end of the year, thus completing the three years' circumnavigation cruise. On the trip from Coronel, Chile, to Port Stanley, Falkland Islands, made in December and January last, she encountered an exceptionally smooth passage in rounding the Horn. However, on her run from the Falkland Islands to St. Helena, February 22 to April 3, twenty-three icebergs were sighted. The vessel is in command, as heretofore, of Mr. W. J. Peters.

The annual report of the National Academy of Sciences shows that appropriations from the Bache fund amounting to $2,000 were made as follows:

J. A. Parkhurst, Yerkes Observatory, Williams Bay, Wis., for the determination by photographic methods of the visual and photographic magnitudes and the spectral types of faint stars, $500.

M. A. Rosanoff, Clark University, Worcester, Mass., for the determination of the several factors that influence the velocity of sugar hydrolysis, $500.

S. C. Chandler, Wellesley Hills, Mass., for the definitive discussion of the latitude variation from 1725 to the present time, $350.

F. B. Sumner, additional grant for the continuation of experiments on the effects of external conditions on growing white mice, $150.

T. A. Mann, Concord, N. H., for the determination of the cause and mode of spread of septic sore throat, $100.

S. F. Acree, Johns Hopkins University, Baltimore, Md., for the completion of the study of the action of alkyl halides on sodium phenolate, $500.

E. H. Hall, Harvard University, for the study of the electromagnetic and thermomagnetic behavior of metals, $500.

One of the last official acts of President Taft was the signing of a proclamation eliminating 41,150 acres from the Kansas National Forest. The tract eliminated is in the extreme western section of the forest, and includes all that part which lies west of the fifth guide meridian. It is principally a sandhill country and while it could be reforested, there is such a large proportion of alienated or privately owned land within the forest boundaries that the government's reforestation work would have to be confined to more or less isolated areas. Since the area is valuable for grazing, its restoration to the public domain was deemed advisable. At the same time that the land was eliminated from the forest it was withdrawn from entry, under the authority which congress has given the

president to withdraw land from all forms of entry except as to mineral claims for the development of metalliferous ores. The land will be restored to settlement and entry after such advertisement in the local papers as the secretary of the interior may consider necessary. The Forest Service is successfully reforesting a considerable area in the sandhills of Nebraska and Kansas, where the soil is so loose in texture that it blows away as soon as it is cultivated. Therefore, according to the government's foresters, the problem has been to grow trees in competition with the native grasses, both making rival demands on the small amount of moisture. If the grass cover is removed the soil blows out completely and exposes the roots of the trees. The success already attained indicates, in the judgment of the government foresters, that a large part of the sandhill country will become timber-producing.

THE quantity of briquetted fuel manufactured in the United States in 1912 showed a small gain over the output for 1911, and according to E. W. Parker, of the United States Geological Survey, the briquet industry may be considered as now passing out of the experimental stage and assuming a more substantial and permanent character. The quantity of briquetted fuel made in 1912, at 19 plants, was 220,064 short tons, valued at $952,-261, as compared with 218,443 tons valued at $808,721 in 1911. Of these plants 7 used anthracite culm, 9 used bituminous or semi-bituminous slack, 1 used residue from gas manufactured from oil, 1 used mixed anthracite culm and bituminous slack, and 1 used peat. The largest producer of briquets in the United States in 1912 was the Berwind Fuel Company, of Superior, Wis., the output of which was a little in excess of 50,000 short tons. The quantity of raw material available for the manufacture of briquets, as stated by Mr. Parker, is ample and may be obtained at slight cost. The most desirable material for producing a smokeless product is anthracite culm, a plentiful supply of which still remains in the anthracite region of Pennsylvania and more is produced daily in the mining operations. It is not too much to believe or to hope that in the near future the small sizes of anthracite, such as buckwheat and smaller, that are now sold for making steam, in competition with bituminous coal and at prices below the actual cost of production, will become more valuable as a raw material for the briquet manufacturer. The output of these small sizes, produced by breaking up large coal to obtain the domestic grades—egg, stove and nut—exceeds 20,000,000 long tons annually, exclusive of 3,000,000 to 4,000,000 tons annually recovered from the culm banks by washeries. The present revenue from this product will not exceed $30,000,000. Washery and small size coal is worth from 50 cents to $1.50 a ton, the price depending on the size. As briquetted fuel it should be worth as much as stove or egg coal, or $3 to $4 per ton. The cost of briquetting is $1 to $1.25 per ton. The uniform size of the briquets makes them desirable as a domestic fuel; besides if properly made they are completely consumed and do not produce clinkers.

UNIVERSITY AND EDUCATIONAL NEWS

PRINCETON UNIVERSITY has received three gifts: $100,000 from Mr. and Mrs. Russell W. Moore, of New York City, to endow a professorship of chemistry; $125,000 given anonymously for a professorship not named, and $30,000 from Mr. John D. Cadawallader, of New York City. About $70,000 were received for current expenses.

THE decision of the jury in the case of the will of Mr. C. H. Pratt being in its favor, the Massachusetts Institute of Technology will receive the bequest, amounting to three quarters of a million dollars, to be devoted to the establishment of a Pratt School of Naval Architecture and Marine Engineering. The requirement that the money actually in hand shall be held by the trustees till it amounts to the specified sum will not cause any delay, since the estate has proved to be of such value as to lack only a few thousand dollars, and will be of the requisite amount by the time the institute is ready to use it.

Whitall Hall, of Haverford College, which houses the scientific departments, was damaged by fire on April 8, with a loss estimated at $20,000.

The board of trustees has approved plans for an addition to the Women's School of the Carnegie Institute of Technology.

New buildings of the Sorbonne, Paris, have been erected at a cost of 782,000 francs. They are the Curie laboratory, under the direction of Mme. Curie; the radium laboratory, under the direction of M. Debierne, and the Pasteur laboratory, under the direction of M. Regnaud.

Professor Alexander Smith, administrative head of the department of chemistry in Columbia University, has accepted the position of professor of chemistry on the Wyman Foundation in Princeton University, and the headship of the department of chemistry. By the desire of the authorities of Columbia University, as well as his own, he will complete three years of service with Columbia University and will accept this call to take effect at the end of the academic year 1913–14.

Dr. William Trelease, director of the Missouri Botanical Garden from 1889 to 1912, has accepted the position of professor of botany and head of the department of botany at the University of Illinois.

DISCUSSION AND CORRESPONDENCE

ON METHODS OF TEACHING MODERN LANGUAGES

The basis and warrant of all language teaching must be psychological. But among all the multitudinous articles and books on the subject, there are only a very few which take cognizance of the psychology of language teaching, although, to be sure, the practical application of the principles is practised in part, consciously or unconsciously.

The test of any method must be psychological. Here mere practical results can not be the criterion. The question should not be: Has the learner acquired so and so much of a vocabulary? but rather it should be: Has the learner been acquiring good *mental habits* while he has been acquiring the vocabulary? That is to say, the method must be based upon sound laws of the mind, to follow which means to produce good *habits of study*.

1. The newer school of linguists are agreed that language is an activity of the mind; not a thing thrust upon the individual, but rather the outward manifestation of mental states.

Speech without ideas is useless. Adults do not naturally learn words for the sake of learning them, but only for the purpose of expressing ideas. We find in normal adults first the idea, then the expression of it, or possibly the two simultaneously, but not the reverse.

2. Physiological psychology teaches us that four distinct centers of the brain are active in the acquisition of language; namely: the auditory, the visual, the motor writing, and the motor speech centers, the first two sensory, the latter two motor.[1] The function of the auditory center is to receive sensory impressions through the nerves of the ear; that of the visual center to receive impressions from the nerves of the eye; the motor-writing center controls the muscles of the hand in writing, while the motor speech center controls the muscles of the speech organs.

It has been established, also, by experimentation that the strength of the sensory impressions upon these centers varies with different individuals. There are those who get stronger impressions by the auditory than by the visual center, and more facile expression by the motor-speech than by the motor-writing center, and *vice versa*.

Moreover, there are in the case of the four brain centers under discussion not only nerve currents from the end-organs to the centers and from the motor centers to the muscles, there are also the association areas of the brain which serve communication between these centers, thereby bringing about a lively interaction between them.

3. Without going into the old question whether sensation is the sole principle of knowledge, we are on safe ground psycholog-

[1] Cf. Wundt, Wilhelm, "Principles of Physiological Psychology," English translation, London and New York, 1904, pp. 302 ff.; Judd, C. H., "Psychology, General Introduction," New York, 1907, pp. 51 ff.

ically when we assert that in learning a language auditory, visual and kinesthetic sensations play the most important rôle, and are in fact the basis of knowledge. It follows then that the greater the number of sensory impressions that can be enlisted in the acquisition of language, the greater the acquisition. It follows also that the more combined the activity of the senses, the more rapid and the more thorough will be the organization of the speech centers physically and psychically.

4. From perceiving sensations, that is, from percepts, the mind proceeds, by discriminating, comparing, judging from knowns to unknowns, to form concepts.

5. Retentivity depends for its strength upon the strength of the original impression and upon the frequency of repetition. It shows greatest virility in the retention of linguistic forms when the four speech centers operate to heighten the intensity of the impression.

6. Beyond this there is the ideal of persistence which is strengthened by resolutely overcoming obstacles, *e. g.*, by mastering assigned tasks of difficulty sufficient to form a real obstacle to their consummation.

What do these facts mean to the teacher of language, and how should pedagogy make use of them?

1. It is unnatural and hence poor pedagogy to teach isolated words, and to proceed from the parts to the whole; that is, here, from the isolated vocables to the sentence, the judgment. The reverse: from a consideration of the whole sentence to a consideration of the parts is the law of nature, and is a good psychological principle.

Thus the argument which is often used against the analytical or direct method that adults do not learn language like children do loses much of its force. Certain it is that for adults the idea comes before the sign for the idea, although, to be sure, the mature mind, accustomed to abstract thinking, soon demands that it be given not only the percepts but the concepts, and the general concepts as well.

2. Good pedagogy should call into activity all the powers of the mind of the learner. Thus in the case of the language teacher, to utilize the visual and the graphic centers only, and allow the auditory and the motor speech centers to lie barren, is to get only a portion of the sensory impression that may be got if all the centers are utilized.

Again, since some individuals of a group will learn better by the utilization of the visual and the graphic centers, others by the utilization of the auditory and the motor-speech centers, etc., every course in language should give opportunity for both forms of impressions and both forms of expression, *i. e.*, for hearing, and seeing (reading); for speaking and writing.[2]

3. Language study is best cultivated by utilizing the nervous energy of all four centers, that is, the ear, the eye, the vocal organs and the hand. Each must support the other, thus heightening the total impression.

4. Generalizations, in this case principles and laws, must base upon sense perceptions, in this case spoken or written words and phrases, and must follow, not precede them. Ample opportunity is demanded to discriminate between various cases, genders, numbers, persons, tenses, modes, etc.; also between the various shades of meaning in words, and various modes of expression with slightly varying significance; also opportunity to make combinations as in reasoning from known roots to the various compounds of such roots, etc.; also opportunity for comparisons as in comparing the idioms of the foreign tongue with the mother tongue, as *e. g.*, in translating.

5. Retentivity depends upon the strength of the impression received in the class room. Aural impressions are heightened by visual, graphic and oral impressions. Since retentivity depends upon the frequency of the im-

[2] It has been claimed that Americans are visualizers, and from this it has been argued that the reading method is the best for Americans. But it is a patent fact among psychologists that the combined action of the four speech centers is stronger than that of any one of them, and thus this argument falls flat. Moreover, the visualizer, above all others, needs to have his auditory and other centers developed.

pressions, language material must be worked over repeatedly in various ways, thereby insuring permanence of the impressions. The natural association of name and object must be made use of. That is, the learner shall not be taught to think from the foreign symbol to the symbol of the mother tongue, and from that to the object, but he shall be taught to think in the foreign language from the thing to the name and *vice versa,* just as he does in the mother tongue.

6. The ideal of persistence must be enforced by accomplishing set tasks, tasks sufficiently difficult, and including not merely memory work but reasoning as well, as, for instance, translation and "free composition," in which he compares and discriminates, chooses and rejects.

The imagination, the esthetic and the moral feelings must be fed by reading literature of high moral and esthetic standard, and by laying emphasis on the qualities which are to be inculcated.

Charles Hart Handschin

ACADEMIC FREEDOM

To the Editor of Science: In the current issue of Science is a letter on the subject of academic freedom, in which is given a quotation from an address delivered some years ago by President Schurman. Your correspondent regards the statements in the address as highly commendable, but it seems to me that the address contains within itself the "enzym" of its decomposition.

Academic freedom is like friendship "but a name that lures the soul to sleep." Freedom of teaching is permitted only so long as no serious attack is made on widely received opinions. As the "Professor" says, in Mallock's "New Paul and Virginia," "Opinions can only be tolerated when they lead to no possible consequences." Let us suppose, for instance, that when Professor Schurman's address was published, a subordinate instructor in the university had spoken as follows: "When President Schurman speaks of 'God's truth' he speaks of something about which he knows no more than a gibbering idiot in the nearest asylum. God, if he exists, has apparently not declared himself to anybody. All such allusions are either mere catering to popular superstitions, or are on the same plane as the beliefs of the lowest savages." How long would this instructor retain his place in the university? I would be pleased to hear what your correspondent would advocate concerning a person who should so express himself. A hundred other examples can be selected. What would become of a subordinate instructor who should at a Washington's birthday address say that Washington was a traitor and should have been hanged by the British, if they had caught him.

Henry Leffmann

When the necessity of freedom for university teachers and investigators is emphasized, it is never assumed that this freedom carries with it a license to do or say anything and everything. University teachers do not claim that they constitute a class with special privileges. But as a body of men with serious and important work to do, they claim the freedom that is necessary to enable them to perform this work and to fulfill their obligations to society. Freedom in this field, as everywhere, is a reasonable freedom, involving law, responsibility and due regard for others. Academic freedom has its roots and its justification in the duty which the teacher owes to his students and to the community. It may well be that at times it is just as important to emphasize this duty and responsibility as to call attention to the necessity of freedom. But one side is the counterpart and complement of the other: where there is no freedom there can be no responsibility, and where there is no feeling of responsibility there can be no genuine freedom. If this is true, it would seem to follow that the limits of a reasonable freedom can not be fixed by any abstract definition. What are the reasonable limits in any particular case must be decided by the whole set of circumstances, as judged by reasonable men living in a reason-

able society. Of course this involves a circle; but there is no way of escaping it.

J. E. CREIGHTON

SCIENTIFIC BOOKS

An Introduction to the Study of the Protozoa. With Special Reference to the Parasitic Forms. By E. A. MINCHIN, Ph.D., F.R.S., Professor of Protozoology in the University of London. London, Edward Arnold; New York, Longmans, Green & Co. Pp. x + 517. Price $6.00 net.

When an "Introduction" to the study of a special group covers over 500 pages of which perhaps a third are in fine print, a reader might infer that the main text would require a lifetime to prepare and digest. Of the many students of the group described in this book not a few have given an entire lifetime and others are now devoting all of their energies to the main text. Amongst these Professor Minchin is one of the most conspicuous and best informed. We think, however, that he is a trifle too modest in calling this splendid presentation of a difficult field an "Introduction," for the great variety of subjects discussed, the judicial attitude assumed, and the wealth of references used, are more characteristic of a treatise than of a primer.

Like the majority of general works on Protozoa, this one consists of two main sections, one devoted to general problems, the other to special groups. Such treatment involves more or less repetition and requires many cross references, but is most useful in picturing the nature and extent of problems in general biology, as illustrated by the Protozoa. In the general section four chapters are devoted to the distinctive characters, modes of life, general physiology and reproduction; five chapters to the general organization and life cycles, and one chapter to fertilization and sexual phenomena of the Protozoa. In the more special part, one chapter is given to the Sarcodina, two to the Mastigophora, three to the Sporozoa and one to the Infusoria, while a concluding chapter deals with the general phylogeny of the Protozoa and with two doubtful groups, the Spirochætida and the Chlamydozoa. The sub-title of the book disarms criticism of the disproportionate treatment of the four special groups, the Infusoria receiving the least attention, but such treatment may go a long way in overcoming the too-common generalization that ciliates are *the* Protozoa, and may help to a broader comprehension of the biological value of representatives of the other and larger groups of unicellular animals.

The problem of karyokinesis, especially the evolution from simple to complex mitotic structures, is well treated; a more critical discussion of the so-called chromosomes in Protozoa and the evolution of chromosomes would have been a welcome addition, since there is the greatest confusion at the present time over this apparently simple matter. The terms "chromatinic" and "achromatinic" are used in place of chromatic and achromatic, the change being adopted on the ground that the latter terms have a distinctly different meaning in optics. We agree that the change is desirable, but there is little probability that it will have a wide following, since these terms are firmly grounded in modern biology. Another new term—"chromidiosome" for the smallest unit of chromatin inside or outside of the nucleus, is most useful so also is the word "endosome" for the German term "Binnenkörper."

Minchin makes a distinction between Protozoa of "cellular" grade and those of "bacterial" grade, but the effort seems to be somewhat obscure and does not help much in defining the Protozoa, having a perplexing rather than a simplifying effect. The bacterial nucleus is sometimes a single karyosome which might be compared with a typical nucleus; more often there is no morphological nucleus, but chromatin granules are scattered about the entire organism. It is presumably this type of bacterial structure that Minchin refers to in Protozoa of bacterial grade, and if so the Spirochætes might well fall within such a group; but these are treated separately as a doubtful group. On the other hand, some well-defined Protozoa, such as *Dileptus gigas*, for example, have similar scattered chromatin

masses, but could scarcely be considered of bacterial grade. Certainly all undoubted Protozoa are of the cellular grade and are characterized by nuclei more or less different from typical nuclei of tissue cells.

The discussion on syngamy and sex, although slightly halting in argument, is admirably presented. Minchin apparently favors the rejuvenescence theory, but finds a logical difficulty in the phenomena of parthenogenesis and autogamy and has apparently overlooked some recent work on variations as an outcome of amphimixis, as well as works recording failures to rejuvenate after conjugation in cultures. This general problem, however, has been so recently re-opened that the literature may not have reached him in time to be incorporated.

In dealing with the flagellates, especially the blood-dwelling forms, Minchin is perfectly at home and speaks with a first-hand knowledge that carries conviction. The life histories of the Trypanosomes and other hæmoflagellates are given with a firm touch and many of the facts are from his own hitherto unpublished results.

In the section on general physiology the usual physiological activities are concisely, but well, treated. The matters of degeneration, regeneration, and the phenomena of decreasing vitality in Protozoa are somewhat disappointing in the mode of treatment; so also is the neglect, throughout the volume, of evidence derived from the study of various types of Protozoa by the bacteriological culture methods, which for certain groups of the Protozoa, notably the Amœbæ, promise to throw a flood of light on the vexed question of pathogenic species. It is most uncharitable, however, to cavil over these minute defects, if indeed they are defects, when the vast and rapidly growing literature on the Protozoa is so admirably welded together in a readable whole, and we shall have occasion many times repeated, to thank the author for his labor, his critical insight, and for the judicious care with which he has selected the material embodied in this volume.

Gary N. Calkins

Food in Health and Disease. By Nathan S. Davis, Jr., A.M., M.D. P. Blakiston's Son & Co. 1912. Second edition. Pp. 449.

It is fair to assume from a statement in the preface that the author expects this work to be used in the instruction of physicians and nurses. It would seem desirable that any publication to be used in this way for instruction in the principles of nutrition should present the latest and most reliable knowledge. This volume fails to meet this requirement. Not only does it contain many statements which must be regarded as erroneous, but some of the most important advances in our knowledge of food chemistry and metabolism receive no consideration.

One looks in vain, for instance, for a discussion of the recent additions to our knowledge of the efficiency of individual proteins for constructive and maintenance purposes. Osborne and Mendel have shown that the alcohol-soluble protein of maize, when it is the only protein fed and is supplemented by the other classes of nutrients in efficient forms, does not serve to maintain life, much less build tissue. Marked differences are observed in the efficiency of other proteins. Without question, the influence of certain food substances upon the secretion of the digestive fluids should also receive extended attention in a study of dietetics. It would seem that whoever is to assume the direction of the diet of the well and the sick should have some inkling of this most important new knowledge.

It is easier to be charitable toward omissions of this kind, however, than towards inaccuracies and looseness of statement. It is fair to inquire what justification there is for the statement that carbon dioxide "aids digestion by promoting chemical changes and muscular activity." The statements that "tissue waste is most rapid under a protein diet," "that nitrogenous food in greater quantities than are strictly needed to maintain nitrogen equilibrium will cause a waste of tissues as well as repair," and "in other words, all changes are stimulated by proteins," are most surprising. It is true that the body tends to

adjust its protein catabolism to the protein supply and that a sudden increase of protein in food causes a quite immediate increase in protein cleavage. This does not mean, however, that an excess of protein causes tissue waste because this increase in protein catabolism, due to an increased protein supply, undoubtedly occurs at the expense of nitrogen compounds that are still in a circulatory or labile condition.

There can be no disputing the fact that "animal food requires a considerable quantity of oxygen for its utilization"! It is well established, to be sure, that the amount of heat liberated by the use in the body of a given volume of oxygen is somewhat less for proteins than for carbohydrates. In view of the facts that oxygen consumption is practically proportional to the amount of energy developed and that all the nutrients require for their oxidation in the body "a considerable quantity of oxygen," the above statement seems to be somewhat peculiar in form, to say the least.

We are not told on what experimental evidence it is asserted that proteins are required for the production of nervous energy, nor is the difference between nervous energy or any other energy explained.

To make the terms "fibrinogen" and "casein" synonymous as the principal protein in milk is hardly excusable. Fibrinogen is a term given to the mother substance of fibrin. It is possible that the author had in mind caseinogen, a name once proposed for the casein of milk before coagulation.

Starch, cereals and vegetables, when cooked imperfectly, are characterized as "indigestible" and we are told that a "vegetable protein is very imperfectly digested and absorbed." In the first instance, the term indigestible may be used in the popular sense, difficult of digestion, for the author, in several places, confuses the meaning of the terms digestion and digestibility, but to state that a vegetable protein is very imperfectly digested and absorbed is, as a general statement, in utter defiance of facts. The records of digestion experiments with human foods show that on the average between 80 and 90 per cent. of the protein of cereals, vegetables and fruit is digested and absorbed. Vegetable proteins, according to this author, "are mostly globulins." The proteins of wheat flour, of which we consume more perhaps than any other vegetable forms, consist chiefly of glutenin and gliadin, neither of which is globulin. It does not appear to be true that globulins predominate in other cereals. Legumin is made to resemble casein "in many of its chemical reactions." We now know that the legumins are globulins and they appear to have little similarity to the principal protein of milk. The theory that by churning "the albuminous envelopes of the fat globules of the cream are broken and the fat particles are permitted to commingle and form a solid mass" was abandoned long ago. Those who are making a study of milk advance the theory that by adsorption the fat globules cause a concentration of albuminous matter around them, but the breaking of the envelope through the agitation of the cream is now not accepted. The statement that sodium chloride acts in the blood as a solvent of the globulins would seem to be somewhat precarious.

In discussing cow's milk, the author informs us that "after the first week, it is usually the richest and remains about the same for months, provided the animal's diet is uniform." The fact is, as shown by numerous analyses of the milk of cows through the entire period of lactation, the milk is the least rich a few weeks after parturition and increases in richness as the period of lactation progresses, especially when there is a decrease in the yield. It seems to be assumed that a change in diet changes the composition of the milk which, in the main, is contrary to the results of extended observations.

When the author enters the field of practical dietetics, he still seems to be subject to error. In dealing with the influence of the diet upon the mother's milk, he gives a set of rules which, in the light of recent observations, should be lightly regarded. For instance, we are told that to increase the total quantity of milk and to decrease the total solids, there should be an increase in the proportion of

liquids in the diet. Such investigations as have been made do not bear out this statement. Nuts are said to be of little value as food, but their composition and digestibility show them to be highly nutritious. Fish is classed as "an economical kind of protein food." This may be true of certain species, especially when salted or smoked, but some species when bought in the fresh condition, as for instance blue fish, furnish a very expensive diet, much more so than even the expensive meats.

Gravity cream is said to contain 16 per cent. of fat. If the term "gravity" is used in the usual sense as applied to cream raised by deep setting and pan setting, then under some conditions it would contain double that percentage of fat and even more. Cream does not have a uniform composition, but varies greatly according to conditions.

It is hardly necessary to multiply these references. There is running through the first part of the volume, which relates to the general principles of nutrition, a general tendency to inaccuracy and indefiniteness of statement. For the purposes of instruction, the language might wisely be condensed and reference to unimportant details omitted.

No discussion is attempted in this connection of the author's recommendations as to the diet for invalids and for persons in health under various conditions because he states that the recommendations "are largely based upon my own observation" and such observations constitute original data. No intelligent discussion is possible unless the extent and character of these data are understood.

W. H. Jordan

New York Agricultural Experiment Station

Home University Library of Modern Knowledge. Edited by Herbert Fisher, Gilbert Murray, J. Arthur Thomson and William T. Brewster. New York, Henry Holt & Company.

The Cambridge Manuals of Science and Literature. Edited by P. Giles and A. C. Seward. New York, G. P. Putnam's Sons.

An anecdote which greatly impressed my boyish imagination some thirty-five years ago related to certain little scientific primers in terra-cotta colored cloth, written by such men as Huxley, Tyndall and Lubbock, and published, I think at a shilling, by Macmillan. The story was that some one had remonstrated with Macmillan for getting such eminent men to prepare these simple little works, when "any schoolmaster could have written them." The publisher replied that his experience had shown him that it took just such men to write good primers; that it was one of the most difficult things to accurately and effectively present the gist of any scientific subject, and attempts to have such work done cheaply by inferior men had always given more or less unsatisfactory results. Since that time multitudes of elementary scientific works have appeared, and the opinions attributed in the story to Macmillan have not been shared by all their publishers. We could hardly say, at the present time, that excellent works may not be written by men of small scientific reputation; but it assuredly remains true that they must be written by men of good training and ability. The abounding faults of our current text-books bear witness to the reprehensible lightness of heart and mind with which, in a commercial age, the teaching profession attempts to gain money and reputation.

The two series of volumes now before us, issued from New York, but prepared and originally published in England, represent new attempts to carry out the Macmillan plan. Essentially products of the universities, they are part of the general scheme of "university extension" which now finds so much favor. Varying greatly in literary and perhaps scientific merit, they maintain on the whole a high standard; and in nearly every case it may be said that the author is an eminent representative of the branch of science he discusses. The field covered is so large that no reviewer can critically consider more than a small minority of the volumes, yet in a sense he can judge best the ones on unfamiliar sub-

jects, testing by his own experience their power to interest and instruct. Tried in this way, I have found many of these little books quite inspiring, and have learned much from them.

The Home University Library volumes are larger and more pretentious, averaging about 250 pages, but selling at the very moderate price of 56 cents, post free. The Cambridge Manuals, with about 150 pages, sell for 40 cents net. The general appearance of the Home University volumes is very good, but I do not like the "rose-colored art cloth" of the Cambridge books, while the cover design, reproduced from a wood-cut of the year 1581, is ugly if historically interesting. The Cambridge Manuals usually deal with more specific or limited topics than the other books, and consequently are often more detailed or concrete. From the standpoint of a student this seems to be an advantage. The volumes are too numerous to be separately reviewed in detail, but a few notes on some of them may be useful.

Home University Library

Matter and Energy. By F. SODDY.

Very interesting and useful to one who is not a physicist. It is worth while to quote a few stimulating paragraphs:

> Our most fundamental conceptions are, like ourselves, material. The elaboration of them is easy, but their simplification to suit the immaterial world, whither we now wish to embark, is difficult almost to impossibility. If our minds habitually thought in terms of electricity and magnetism instead of in terms of matter and motion, what a world would be opened up! (p. 165).
>
> Modern science, however, and its synonym, modern civilization, create nothing, except knowledge. After a hand-to-mouth period of existence, it has come in for and has learned how to *spend* an inheritance it can never hope to restore. The utmost it can aspire to do is to become the Chancellor of Nature's Exchequer, and to control for its own ends the immense reserves of energy which are at present in keeping for great cosmical schemes (p. 247).

We may not be inclined to take all this quite literally; thus, civilization is not really synonymous with science, even in its modern developments; but it is all very interesting and productive of thought.

The Making of the Earth. By J. W. GREGORY.

Parts of this seem rather uncritically written. We are astonished to read (p. 127) "the evidence, therefore, of the distribution of animals and plants proves the former existence of continents that have been dismembered and of land routes that have foundered beneath the oceans"; and there is actually a full-page map showing the distribution of the Acræidæ, a tropical family of butterflies, as part of the important evidence of land routes across the present oceans! On p. 244 it is stated that the first traces of vertebrates are Silurian, whereas it is generally considered that America yields Ordovician fish remains.

Anthropology. By R. R. MARETT.

Written in a breezy style, with due regard to the idea that "the 'dry bones' of history, its statistical averages, and so on, are all very well in their way; but they correspond to the superficial truth that history repeats itself, rather than to the deeper truth that history is an evolution. Anthropology, then, should not disdain what might be termed the method of the historical novel. To study the plot without studying the characters will never make sense of the drama of human life" (p. 242). On p. 40 it is implied that the antiquity of the Calaveras skull is still a matter of opinion. Here and there, the flow of rhetoric appears to lead to some looseness of statement, as when it is said that Wallace discovered the law of natural selection "at the same moment" as Darwin, instead of independently, as it should have been.

Man. A History of the Human Body. By ARTHUR KEITH.

Very interesting, with a good deal of information which will be new to the average biologist; some of it in fact based on new work by the author. We may perhaps object to the account (p. 171) of *Pithecanthropus* as "the fossil man of Java," without any expression of doubt regarding its humanity.

On p. 237 bacteria are called "fauna." Comparing the very different styles of the books on Anthropology and Man, I think it must be admitted that that of the latter is preferable.

A few others of special interest must be mentioned:

Psychology. By William McDougall.

The Principles of Physiology. By John Gray McKendrick.

Electricity. By Gisbert Kapp.

The Cambridge Manuals

Links with the Past in the Plant World. By A. C. Seward.

An admirable introduction to paleobotany, by one of the greatest authorities on that subject. As a frontispiece we have a picture of *Sequoia magnifica* in the Yellowstone National Park. A particular merit of this book is its treatment of living and extinct plants together, showing how they throw light on one another; it is especially to be commended to those botanists who think themselves excused from any consideration of fossils.

Primitive Animals. By Geoffrey Smith.

A most instructive treatment of the primitive members of various phyla. Used as a text-book, it might be made the basis of a very interesting introductory course in zoology. On p. 41, the account of the distribution of *Peripatus* is incomplete, and inaccurate in the statement that the animals do not occur in the northern hemisphere. It is also no longer permissible to speak of "a small number of closely related species," in view of such works as Bouvier's Monograph. The classification of animals at the end of the book is modernized, but the "Myriapoda" are left to include both centipedes and millipedes.

The Individual in the Animal Kingdom. By Julian S. Huxley.

An essay in zoological philosophy, or philosophical zoology, influenced, as stated in the preface, by Bergson. Well-known facts are brought forward to show how difficult it is to define an "individual," and it is finally concluded that individuality is a tendency which may be manifested in varying degrees. Consequently the author makes the term cover cases in which he sees this tendency, although most of us, simply as a matter of nomenclature, will hesitate to follow him.

> The communities of ants and bees are undoubted individuals. . . . When we come to man, this power possessed by one unit of entering into more than one individual "at once" becomes very marked. A man can very well be at one time a member of a family, a race, a club, a nation, a literary society, a church and an empire. . . . It yet remains true that the state or society at large is still a very low type of individual: the wastage and friction of its working are only too prominently before our eyes (pp. 142–143).

Earthworms and their Allies. By Frank E. Beddard.

This deals principally with the geographical distribution of earthworms, but also contains a good account of their structure. The author is of course a well-known authority both on earthworms and distribution in general. I found the work very interesting, but I fear many will be repelled by the multitude of names of genera and species.

Prehistoric Man. By W. L. H. Duckworth.

An up-to-date account of what is known about early man—yet of course not *quite* up to date, as it was printed before the recent discovery in Sussex. So far as I can judge, it seems to be admirably done, and one is really astonished at the mass of information gathered in recent years. All the really important contributions have been from the old world, and "it is important to notice that time after time the attempts made to demonstrate the early origin of Man in the American continent have resulted in failure, which in some instances has been regrettably ignominious" (p. 55).

Other interesting volumes are:

Spiders. By Cecil Warburton.

Life in the Sea. By James Johnstone.

House Flies, and how they Spread Disease. By C. G. Hewitt.

The Migration of Birds. By T. A. Coward.

The Work of Rain and Rivers. By T. G. Bonney.

The Natural History of Clay. By ALFRED B. SEARLE.

The Origin of Earthquakes. By CHARLES DAVISON.

Rocks and their Origins. By GRENVILLE A. J. COLE.

The Modern Locomotive. By C. EDGAR ALLEN.

Considering that high general level of excellence, together with the very moderate prices, it would seem that almost any public library or large high school would do well to obtain both series. The treatment, usually different from that of the conventional text-book, is likely to interest many readers, some in one subject, some in another. There is not as much duplication in the two series as some of the titles might suggest; thus "Anthropology" and "Man" in the one do not at all take the place of "Prehistoric Man" in the other.

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On the Foundation and Technic of Arithmetic. By GEORGE BRUCE HALSTED. Chicago, The Open Court Publishing Company. 1912. Pp. 133.

The main purpose of this book is to place the number concept of modern mathematics within easy reach of the teacher in the grades. That there is reason for the existence of such a text is apparent from the fact that people in general and to some extent even teachers of arithmetic still look upon mathematics as "the science of quantity." The primitive number concept of modern mathematics has nothing to do with quantity. Mathematical research on this subject has been slow in commanding the attention of non-mathematicians. It is not very many years ago that a prominent American psychologist published a book in which the simple act of "counting" was declared to be an act of "measuring." It is not very long since, that a series of arithmetics was published in which the primitive idea of number was presented as being that of "ratio." Dr. Halsted brings out clearly and strongly the fact that primitive number, whether considered from the standpoint of its modern logical exposition, or from its historic development, is wholly divorced from measurement, and that number viewed as a ratio presupposes counting and is a more involved concept. The book under review contains an able presentation of fundamental concepts. This every one familiar with Dr. Halsted's earlier works had reason to expect.

The leading topics discussed in the book are as follows: The genesis of number, counting, genesis of our number notation, addition, multiplication, subtraction, division, decimals, fractions, measurement, mensuration, order, ordered sets, ordinal number, the psychology of reading a number, arithmetic as a formal calculus, suggestions on the teaching of arithmetic.

Halsted makes the interesting observation that, besides the "ordinal number" and "cardinal number," modern civilization has introduced "nominal number" used as a proper noun, as in the telephone service. "Since the size of the number and its place in the number series are here alike irrelevant, the whole stress falls upon its recognition as a unique name."

The text contains numerous historical statements, some of which are open to criticism as not embodying the latest researches. Moreover, there is a frequent lack of bibliographical reference to authorities. Thus Halsted gives $\pi = 3.14+$ and $\pi = 3.1416-$ and then adds:

> This is historically the first meaning of the signs + and —, which arose from the marks chalked on chests of goods in German warehouses, to denote excess or defect from some standard weight.

In view of the fact that historians have been in doubt as to the exact origin of + and —, the authority for Halsted's categorical statement would be interesting. Cantor[1] and Tropfke[2] both express themselves with great reserve on the validity of the explanation endorsed by Halsted. Eneström in a later re-

[1] Cantor, "Geschichte der Mathematik," Vol. II. (2), 1900, pp. 230, 231, 320.

[2] J. Tropfke, "Geschichte der Elementar-Mathematik," Vol. I., 1902, p. 134.

search arrives at more positive results, indicating a different origin for +. He shows that in Widman's printed arithmetic of 1489, + had not yet become a purely mathematical sign, that with Widman + meant simply "und" (and), in conformity with a practise of the middle ages, according to which a symbol closely resembling + was used for "et."[3] It is now known that Widman possessed a manuscript algebra in which + is used for "et," even in cases where "et" does not mean addition.[4] Widman in 1849 sometimes indicated subtraction by the special symbol —, a usage found somewhat earlier in a Dresden manuscript of the year 1481.

Halsted attributes decimal fractions to Stevin (1585), but makes no mention of the earlier use of decimals by Vieta[5] (1579) and Rudolff[6] (1530). Halsted mentions Napier (1617) as the first to use the decimal point, but the period (or the comma) was used by Bürgi as early as 1592,[7] by Prätorius in 1599[8] and by Kepler in 1616.

Florian Cajori

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Treatise on Light. By Christiaan Huygens. Rendered into English by Silvanus P. Thompson. London, Macmillan & Company. 1912. Pp. vii + 128.

Ever since its birth, in 1690, the wave theory of light has been adapting itself to environment. Just at the present moment, when the completeness and perhaps the competency of the wave theory is being called in question by certain phenomena of radiation and radioactivity,[1] an English translation of Huygens's great "Treatise on Light" is particularly opportune. The fact that this translation has been made by Professor Silvanus P. Thompson is an ample guarantee that it has been done in a scholarly and sympathetic manner. Two distinct courses are open to one who wishes to transfer into English the thought of a foreign author who lived more than two hundred years ago—either he may employ the English phraseology of our own day, or he may use that which he conceives to have been the current diction of the period in which the work was composed. In either case he must avoid anachronisms, and in either case the problem is difficult. So many modes of expression are common to the languages of western civilization and so many of these forms have disappeared from our language during the last two hundred years, that a certain quaintness is inevitably given to any translation of old French, German, or Italian, in which particular pains is not taken to avoid these obsolete phrases. It is the second of these alternatives which Professor Thompson has chosen. The result is that the volume including its title page, table of contents, text, paper, binding, typography, size, and English style, is as nearly as possible what it would have been if Huygens had lived and worked and published on the other side of the English Channel. This is not to be understood as meaning that the translation is in any sense a literal one, for it is precisely the spirit of the work which Professor Thompson has caught and has faithfully reproduced. In brief the volume is in every way worthy of the great contributions to science which it contains. The first three chapters in which Huygens's principle is enunciated had already been made available to English readers through *Harper's Scientific Memoirs.* But the full evidence for Huygens's principle can only be obtained by understanding Chapters 4, 5 and 6. Atmospheric refraction is explained in Chapter 4 practically as we have it to-day. In Chapter 5 the wave sur-

[3] *Bibliotheca mathematica,* 3 F., Bd. 9, 1908–09, pp. 155–157, 248.

[4] *Bibliotheca mathematica,* 3 F., Bd. 10, 1909–10, p. 182, 183.

[5] *Bibliotheca mathematica,* 3 F., Bd. 11, 1911, p. 340.

[6] *Bibliotheca mathematica,* 3 F., Bd. 10, 1909–10, p. 243.

[7] *Teachers College Bulletin,* 1910–11, No. 5, p. 19.

[8] Cantor, *op. cit.,* Vol. II. (2), 1900, p. 619.

[1] W. H. Bragg, evening discourse before the British Association at Dundee, *Nature,* 90: 559 (1913); R. A. Millikan, vice-presidential address before the American Association for the Advancement of Science, *Science,* January, 1913.

face is worked out for Iceland spar. Here it is shown how a ray may fall obliquely upon a plane surface without suffering refraction. Here too is set forth the invention of the ellipsoidal wave surface to explain refraction in uniaxial crystals—one of the cleverest chapters in the entire history of science. The sixth chapter is given over to "the figures of transparent bodies which serve for refraction and for reflection." Here the principle of "equivalent optical paths" is employed with its well-known elegance. The thanks of all students of optics are due to both translator and publisher for this complete and accurate rendition of a memoir which has long been so rare and expensive as to be practically out of reach of the ordinary reader.

H. C.

SPECIAL ARTICLES

THE HISTORY OF LOST RIVER

In a previous paper written over a year ago and published by the Society for Protection of New Hampshire Forests, in their annual report for 1911, I tried to solve the problem which Lost River presents. Since that time I have made several visits to Kinsman Notch and have each time found new evidence on which to base conclusions. The following paper is offered as a further attempt at an explanation, based on the new evidence.

Lost River is a small stream rising in Kinsman Notch, about seven miles in a westerly direction from North Woodstock, New Hampshire.

The spectacle which presents itself on entering the river is very confusing. The river is immediately lost to view among a mass of huge granite blocks, some of them as large as average dwelling houses. Large potholes are numerous, as well as many beautifully curved water channels. Many of the potholes are fractured and fragments of these lie in the general mass. By careful inspection it is seen that this is an old rock gorge, and that something violent has taken place. Many joint blocks have fallen in, making it impossible to follow the water of the river in its course without ladders and bridges. The Society for Protection of New Hampshire Forests, has purchased 148 acres, including the Lost River and the overhanging cliff, and has placed ladders and bridges in the gorge, so it is no longer difficult to see all the interesting points. There are two sets of caverns (so called because of large vacant spaces between the joint blocks), an upper and a lower. The upper caverns are about one quarter of a mile long. The stream emerges from these at Paradise Falls, flows unobstructed for about 150 feet, and plunges again beneath another mass of joint blocks, the lower caverns. The latter are not so imposing nor as extensive, although very interesting.

In contemplating this heap of granite blocks with the purpose of finding an explanation to the riddle, there are three agents which present themselves as seemingly capable of bringing about such confusion: frost action on a large scale; the disruptive force of a moving glacier; and earthquake action.

There has been considerable frost action in the gorge, and without doubt many blocks have been slowly wedged apart and fallen down from the sides of the gorge. That frost action, however, does not account for all the falling and movement, is to me quite evident. When in the lowest caverns one finds cases where blocks which have slipped from between other huge blocks in place, have left the upper and lower blocks entirely unmoved in the solid ledge. Smooth slickenside-like patches give evidence of a rapid and violent movement. This does not resemble frost action. The fearful confusion and pell-mell attitude of the mass also bespeak something more than the gradual work of frost.

The disruptive force of a moving glacier would seem at first glance capable of creating such a confused mass of joint blocks. It could not account, however, for the movements below the solid ledge, as described above. In one case I found a movement in a lateral direction between two blocks. The lower one is evidently in place and a part of the solid ledge, and the upper one has moved against the direction of movement of the ice about four inches. If ice were accountable for the slip,

surely the lower block could not have been moved, and the upper block would not have moved contrary to the ice motion. If the slipping can be explained by frost action, the positions of the other blocks can not, for they have evidently been thrown about by some other force. Furthermore if moving ice caused the confusion, one would naturally expect to find several different kinds of rock in the gorge. As far as I have explored the river one kind of rock only is present, a rather coarse biotite granite. A dark schist occurs in Beaver Meadows and some fragments of this should be found in Lost River only half a mile away. In the true moraines 100 yards away to the south, abundant fragments of this schist are found, but nothing of the kind in Lost River.

The fact that many of the potholes are cracked, disrupted and weathered as deeply as rocks outside of the gorge makes it evident that most of the potholes were formed before the main force which caused the confusion came. In any event most of the potholes were formed when the river had much more sediment than at present, and presumably this was during Glacial Period times, or at least when the ice had not retreated wholly from Kinsman Notch. The present amount of flow of very clear water is too small to account for the larger potholes. The largest of all is about twenty-five feet in diameter, narrowing toward the top. It has been badly broken and about one half only remains in position.

From the extraordinary positions of some of the water-worn channels it seems possible that much of the water work was done subglacially, although there is no proof as yet that such was the case. The main movement of the great ice sheet was south about 6° west, while Kinsman Notch at Lost River runs nearly east and west. It is probable that the ice in Lost River was nearly stationary during the height of glaciation, and that the main body passed over it with a shearing motion toward the south. The drainage under the ice would follow the present natural slope.

A study of the ground between Lost River and the cliff to the north helps to an understanding of what has probably taken place in the river. The way is difficult and somewhat dangerous. Huge blocks of granite are met with at once. They are piled in a pell-mell manner. As one ascends the blocks become somewhat smaller. There has undoubtedly been a large rock fall and one which immediately suggests a heavy earth shock as the starting force. Gradual weathering and falling would not account for the manner in which the rocks are wedged together. Weathering on all the large blocks of the rock fall, and on those in the river, has gone, as far as I can judge, to the same extent. From this fact it is also natural to conclude that the fall was of a sudden nature and not gradual. If the blocks had fallen one by one, weathering should have progressed to very different extents in different blocks. The granite of the cliff and that in Lost River is the same. There are no traces of any rock but the local granite in the rock fall, so this immediately does away with any ideas of a lateral moraine. It is very evident from the amount of weathering that this rock fall came long ago, and probably soon after the ice of the Glacial Period had retreated from Kinsman Notch.

It is now plain that most of the blocks in the river came from the sides of the original gorge, and not from the cliff, as I had formerly thought. Veins and dikes from the solid walls of the gorge can be found frequently in the loose blocks in the river, close to the places whence they were broken off. It is not always possible to say, on account of breakage, from which side of the gorge they came.

Although most of the blocks in the river came from the gorge itself, the rock fall from the cliff reaches to the very edge of the river, so it is almost certain that a number of the blocks came from the cliff. Surely the large number suggests more than just those which have fallen from the sides of the gorge.

That there was a strong earthquake in Kinsman Notch after the Glacial Period, and that this quake was the prime cause of the great rock fall, and of most of the confusion found at present in Lost River, appears likely. The movements of the joint blocks can not

be accounted for, as far as I have studied them, in any other way. The removal of a tremendous thickness of ice from the White Mountains would naturally require crustal readjustment of no small order, and hence a large earthquake or several of them would not be strange.

The evidences for an earthquake as the principal cause of the confusion in Lost River are: slickenside-like patches on a joint block over which another block had violently slipped; lateral movements among the blocks; the pell-mell manner in which the blocks are heaped; the great rock fall from the cliff, which probably came simultaneously with the shock in the river; the inadequacy of frost action to explain all of the confusion; and the elimination of the disruptive force of a moving glacier.

Although this evidence, positive and negative, does not prove that there was an earthquake in Kinsman Notch, it gives good ground for believing that there was such a shock. I have not overlooked the possibility of a local shock due to the rock fall itself. The effects observed appear too great for the vibrations a rock fall would be expected to produce.

I am greatly indebted to Dr. Philip W. Ayres, Forester of the Society for Protection of New Hampshire Forests, for guiding me to several important caverns which otherwise I must have overlooked.

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AN ANALYSIS OF THE FACTORS CONCERNED IN THE HEREDITY OF COLOR IN TUMBLER PIGEONS[1]

WHEREAS the usual methods for study of heredity serve only to show us the relation of one character to another, this work is an attempt to give our terms concerning heredity of color a real representation in the anatomy and physiology of the bird.

Some of the factors identified in these birds by breeding experiments follow: Red (*R*), Black (*B*), Intense (*I*), Spreading factor (*S*).

The *R* factor (in absence of *B*) is associated with the formation of a melano-protein pigment, distinctly (pigeon) red in color, easily soluble in hot 4 per cent. sodium hydroxide. This pigment is found in reds and yellows. When *B* is present the chemical processes in the skin are profoundly changed, and a dead black exceedingly insoluble pigment is formed. *B* is completely dominant to *R*.

The effects of factor *I*, as seen macroscopically, are quantitative only. When *I* acts on red pigment there is 3.5 times more pigment formed, than when *I* is absent. Acting on black pigment *I* has a value of about 3. The physical form of the pigment is also influenced by *I*. In its absence red pigment exists as irregular masses, when it is present red pigment takes the form of small spherical granules about .4 micron in diameter, etc. On the other hand black pigment exists as spheres even in absence of *I*. When *I* is present black pigment sometimes may exist as rods.

The spreading factor *S* effects a uniform distribution of pigment throughout the barbule. When this factor is absent the pigment is aggregated in clumps, near the center of each barbule cell. This condition changes black to blue and dun to silver. The *S* factor also has an influence on granule form—and this influence varies with the presence or absence of *I*.

There is apparently a far greater mutual modification and interaction of factors in these birds than formulæ derived from external appearance alone indicate.

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[1] Abstract of a paper read before the American Society of Zoologists, Cleveland, January 1, 1913.

A NEW WALNUT

I THINK it desirable to place before the public the fact that I have been growing for eight or ten years a walnut hybrid originating from seed of *Juglans californica* which is a hybrid between that species and some tree, probably a *Quercus* of evergreen habit. As this new form comes true from seed and may be propagated indefinitely, it is worthy of a

specific name. I therefore take this opportunity of giving a few definite characterizations. A lengthy and detailed description will be issued later.

Juglans quercifolia, n. sp. The tree has a habit of growth of a *Quercus,* and in second generation forms it is more or less evergreen, that is the leaves fall late in the season and develop early in the spring. The leaves are trifoliate or unifoliate and the leaflets are circular and very distinct from those of the mother, *Juglans californica.* When there are three leaflets the terminal one is usually the larger. The tree bears nuts similar to those of the mother. The limbs have a small pith cavity which is closely septate. The catkins frequently appear on last year's wood in pairs and are closely approximate, the posterior is usually the shortest at a given date. The color of the new foliage is a darker green than is that of the mother.

Newton B. Pierce

SOCIETIES AND ACADEMIES

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

A special meeting of the society was held in room 43 of the new building of the National Museum at 4:30 P.M., April 1, 1913, the president, Mr. Stetson, in the chair.

Dr. J. H. Gore, who has recently returned from a visit to the King of Siam, read a paper on "Siamese Life and Industries," profusely illustrated by lantern slides. The former included fine basketry, bronze vessels, silver vessels, matting, textile fabrics of silk and other material and hammered silver ware of admirable workmanship, the method of production being to fill a silver vessel with sand and hammer in the surface from the outside to form the ground, leaving the decorative human figures in series (beside other ornaments) in high relief. Usually the figures represent some mythological story. Dr. Gore's lantern-slide pictures of Siam included many farm-scenes, illustrations of games, festivities and elephant-capturing and views of the city of Bangkok, the aquatic human life of its rivers and canals, the palace, imperial crematories and temples, one of the latter being an exceedingly beautiful rock cavern temple of great renown.

Dr. Gore explained that the teak-wood forests and rice culture are among the chief resources of the country, most of the ship-decks of the world being supplied from the former, now managed by an expert forester, while the export of rice is very great, about seventy rice mills of modern equipment being operated in Bangkok, beside, a large amount of similar work done by more primitive methods and appliances throughout the country. The soil is of the highest fertility and unequaled depth in the main valley of the kingdom. There are about eighty miles of good roads around Bangkok and the streets of the city are well made, modern street-car lines running on some of them: but the remainder of the country is practically without roads.

The late king was notable for divers modern and enlightened reforms, such as freeing slaves, relinquishing the royal ownership in the land in the favor of those who had been long in occupancy and use of it, waiving the exemption of the royal lands from taxation and compiling and publishing an edition of the Buddhist scriptures, which he supplied to the libraries of the world.

The inhabitants of Cambodia, he said, are nearly of the same stock of the Siamese, but regarded as inferior by the latter people, whose language is nearly akin to the Sanscrit. The human images before their temples are not idols, but for ornament. There is a flame-like upward aspiring tendency in their decorative work. No magical or religious importance is attached to white elephants, so called, which are albinoes, white only in patches; but these are regarded as rarities and curiosities and as such are given to the king.

W. H. Babcock,
Secretary

PHILOSOPHICAL SOCIETY, UNIVERSITY OF VIRGINIA MATHEMATICAL AND SCIENTIFIC SECTION

The sixth meeting of the session of 1912–13 of the Mathematical and Scientific Section was held March 17.

Professor W. H. Echols read a paper entitled "On the Root of a Monogenic Function inside a Closed Contour along which the Modulus is Constant."

Professor Wm. A. Kepner read a paper on "The Food Reactions of *Amœba Proteus,*" by Mr. Wm. H. Taliaferro and himself.

Wm. A. Kepner,
Secretary

University of Virginia